

## **MONTHLY PROGRESS REPORT Slurry/Micro-Surface Mix Design Procedure November 2003**

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<b>Contract No.:</b>	<b>CALTRANS 65A0151</b>
<b>Agency</b>	<b>Fugro-BRE, Inc.</b>
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### **PROJECT OVERVIEW**

The overall goal of this research is to improve the performance of slurry seal and micro-surfacing systems through the development of a rational mix design procedure, guidelines and specifications.

Phase I of the project has two major components; the first consists of a literature review and a survey of industry/agencies using slurry and micro-surfacing systems; the second part of Phase I deals with the development of a detailed work plan for Phases II and III.

In Phase II, the project team will evaluate existing and potential new test methods; evaluate successful constructability indicators; conduct ruggedness tests on recommended equipment and procedures; and prepare a report that summarizes all the activities undertaken under the task.

In Phase III the project, team will develop guidelines and specifications, a training program and provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines. All activities of the study will be documented in a final report.

### **CURRENT MONTH WORK ACTIVITIES AND COMPLETED TASKS**

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#### **PHASE I—LITERATURE SEARCH AND WORK PLAN DEVELOPMENT**

##### **Task 1—Literature Review and Industry Survey**

###### **Literature Review**

Completed: The literature review process is close to completion with most sources reviewed and summarized in a literature review chapter that will be a major part of the draft Phase I Report. An updated list of references and their review status are given in Table 1.

**Table 1. Literature Sources**

Source	Available	Reviewed
ASTM D3910-98 and ASTM D6372-99 Practice for Design, Testing and Construction of Micro-surfacing	Yes	Yes
ISSA procedures for Slurry Seal Mix Design (A105) and Micro-surfacing (A143)	Yes	Yes
TTI Reports 0-1289-1 & 1289 2-F	Yes	Yes
International Slurry Surfacing Association Conference Proceedings	Yes	Yes
Papers by Robert C. Benedict	Yes	Yes
Transportation Research Board Publications, Research in Progress	Yes	In Progress
European Standards EN 12274-1 to 12274-8 Slurry surfacing Test methods Part 1 to Part 8.	Yes	In Progress
Transportation Research Laboratory Standards (UK)	Yes	Yes
Austroroads – Guide to the Selection and Use of Bitumen Emulsions	Yes	Yes
German Standards	Yes	Yes
French Standards	Yes	Yes
CALTRANS Slurry Study	Yes	In Progress
Technical Guideline: The use of Modified Bituminous Binders in Road Construction. Asphalt Academy c/o Transportek, CSIR	Yes	In Progress
PADOT Research Report No. 89-61	Yes	No
FPRMR Friction Evaluation Study	Yes	No
FHWA-LTPP SPS-3, 4	Yes	No
Ministry of Transportation, Ontario: Micro Performance Study	Yes	No

The general outline for the literature review chapter is given here:

- Introduction
- Extent of Use Worldwide
- Current Mix Design Procedures
- Laboratory Tests
- Critical Factors that Relate to Performance
- Performance of Existing Projects
- Existing Guidelines and Specifications
- Failure Modes
- Benefits and Limitations
- Intended Use and Expectations
- Proposed Framework for Performance Based Design Procedure

Ongoing: The literature review process continued this month with more documents from the initial list of references being reviewed and summarized. Although the literature review chapter will be finalized in December, other literature sources that may become available in the future will be reviewed by the team and included in the summary report later.

New: The European Norms EN 12274-1 to 12274-8 were received this month and are currently being reviewed. In addition, four more documents have been added to the list to be reviewed:

- PADOT Research Report No. 89-61 “Evaluation of Ralumac as a Wearing Course.”
- Foundation for Pavement Rehabilitation and Maintenance Research (FPRMR) “Friction Evaluation of Slurry Systems at Great Bend Kansas Municipal Airport and Newton Kansas Municipal Airport.”

- FHWA-LTPP “Field Evaluation of SPS-3 and SPS-4 Tests Sites.”
- Ministry of Transportation, Ontario “Performance of Micro-Surfacing on High Volume Freeways in Ontario.”

Planned: The literature review process will be finalized in December

## **Industry and Agency Surveys**

Completed: Following our discussion with members of the team and CALTRANS, three surveys were designed:

1. Agencies: using the AASHTO LISTSERVE link.
2. Contractors and Manufacturers: in the United States and the international slurry surfacing and microsurfacing industry.
3. Advisory Panel Contractors.

The three proposed survey questionnaires were included in the August 2003 monthly report and discussed at the videoconference kickoff meeting on September 22, 2003. Based on the comments and ulterior suggestions of the participants at the videoconference, the questionnaires have been revised and included in final form in the September 2003 monthly report.

New: To date, 19 responses have been received from agencies, 21 from the industry and 4 from the advisory panel.

Planned: Once the responses to the questionnaires are received the data will be analyzed to identify the main concerns of agencies, industry and of the advisory panel as related to the project. This analysis will be part of the Phase I Report.

## **Task 2—Work Plans for Phases II and III**

Completed: One of the activities pursued under this task was the review of potential test methods for slurry seal and microsurfacing mix designs. The emphasis was on the humidity variation of the wet cohesion test for potential use in examining curing characteristics under humidity, night, and low temperature conditions.

Continuing discussions on the Phase II Work Plan were conducted by Mr. Holleran and Ms. Goldman. The provisional outline of the Phase II plan is presented below:

### Step 1 Materials Testing

- Screen materials to allow agency to check that correct materials were used.
- No changes for aggregate testing or specifications at this stage.

- Binder recovery method to be ASTM vacuum distillation, Caltrans method, or another appropriate method that does not affect the original binder properties.
- Binder specification to be on base binder and DSR results for 10°C and 35°C to establish thermal susceptibility only (measure  $G^*\sin \Delta$  for the existing commercial range of emulsion binders). Note: The project team is debating these temperatures.
- Establish minimums for recovered binder and allow a maximum percentage change to account for aging or stiffness.
- Wet stripping: Technical Bulletin (TB)-114 would be retained.

### Step 2 Mixing Characteristics

- Trial mixes using hand mixing as per existing ISSA procedure from TB-113.
- German mix cohesion testing on selected mixes to establish a mixing index that will allow use at given temperatures and humidity on standard equipment (this will require standard mixtures being used from known acceptable field mixes).
- Workability Index: This will be based on consistency and spreadability of the mix in a spreader box under different conditions and specifying a maximum cohesion value at a given time.

### Step 3 Cohesion Build Up after Spreading

- Modified sample preparation protocols to take into account night, humidity, and temperatures of cure.
- Modified TB-139 with a new machine measuring torque instrumentally with application of force and response measured either in compression or with confined samples in rubber.
- Test would define:
  - Cohesion at trafficability
  - Cohesion at 24 hours
  - Optimum binder content
- Wet Track Abrasion Test (WTAT) [test with different treatments, e.g., soaking for water resistance] with modification. Consideration will be given to looking at low and high temperature testing. Load variations on the wheels could be used for higher traffic simulations. Variable cure conditions may also be used. Maximum losses would need to be established.
- Modify the loaded wheel and sand adhesion tests. Bleeding is normally due to errors or failing to take temperature and traffic into account; this will be avoided by incorporating variable conditions of load and temperature in this test.

#### Step 4 Long Term Tests

- The main failure modes would be addressed:
  - Cracking
  - Rutting
  - Moisture damage
- Abrasion WTAT.
- Rutting: Wheel tracking test with water.
- Fatigue on section about 40-50mm in length (strain controlled).
- Testing would be done for high, low, and medium.
  - Traffic (loading)
  - Temperature
  - Humidity

#### Step 5 Field Type Tests

- Field Cohesion: measuring resistance to penetration or a shearing torque. This would be for traffic time and for use after 24 hours. Results would require establishment of minimums for field QC, but NOT be mix design parameters.
- Field surface texture measurement by sand patch test or some other texture measurement devise.

The above draft was modified after further discussions between Ms. Goldman and Mr. Holleran. A draft of the experimental matrix has been prepared and discussed at the Nov. 18-19 team meeting in Sacramento.

Planned: The findings of the literature review and the surveys together with the Phase II and Phase III work plans will be included in the Phase I Report. The draft report will be finalized in December and the final report will be provided to Caltrans at the end of January, after being review by the team and the members of the advisory panel.

### **PHASE II—MIX DESIGN PROCEDURE DEVELOPMENT**

#### **Task 3—Evaluation of Potential Test Methods**

No Activity

#### **Task 4—Evaluation of Successful Constructability Indicators**

No Activity

#### **Task 5—Ruggedness Tests of Recommended Equipment and Procedures**

No Activity

### **Task 6—Phase II Report**

No Activity

## **PHASE III— PILOT PROJECTS AND IMPLEMENTATION**

### **Task 7—Evaluation of Potential Test Methods**

No Activity

### **Task 8—Workshop Training Program/Pre-Construction Module**

No Activity

### **Task 9—Pilot Projects/Procedure Validation**

No Activity

### **Task 10—Final Report**

No Activity

## **NEXT MONTH'S WORK PLAN**

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The activities planned for next month are listed below.

- Coordinate with CALTRANS personnel on an as needed basis
- Continue reviewing the documents selected for literature research and acquire the documents currently not available. Continue with the development of the draft literature report.
- Continue development of Phase II and Phase III work plans.

## **PROBLEMS / RECOMMENDED SOLUTIONS**

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The literature review is consuming more time and effort than originally estimated. Given the importance of this first task for the project as a whole, funds from Phase I, Task 2 are used to accommodate the increased effort in Phase I, Task 1. This will not affect the overall project costs or the timely and within budget completion of Task 1.